

A Comparative Study of Three Intelligent Techniques for Malaria in Africa Continent

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ABSTRACT

Diseases are endemic in the Africa continent and one of the problems that affect economic development, malaria and fever is considered one of the most endemic diseases in eastern and central Africa, where Sudan is considered one of the countries in this region where the disease parasite. The proportion of the common symptoms of several types of fevers in this geographical area of Africa it is difficult in many cases determine the malaria fever for other fevers and thus may lead to give the patient treatment is not correct. Through this paper we compare three techniques to help in the diagnosis of malaria fever and other fevers thus giving the correct treatment and to fight the disease and minimize its spread. These techniques which will be used are neural network, genetic algorithm and fuzzy logic.

Keywords

Neural networks, genetic algorithm, fuzzy logic, endemic diseases, parasite, asymptomatic malaria, epidemiological.

1. INTRODUCTION

We Continued growth and rapid growth in the IT field can benefit from it in the process of diagnostic accuracy, and thus determine the correct treatment without mixing with the rest of other diseases. Is artificial intelligence and one from within the computer science that have helped in the process of determining the characteristics and qualities of diseases including malaria . , Malaria is one of the most serious diseases that cause of death in Africa, especially those located in or near the equator line. Human beings always make mistakes and because of their limitation diagnosis would give the major issue of human expertise. So, computer is widely used to help the physician from diagnosing the critical cases. As neural networks can do wonders with missing data, it is widely used for medical applications. Genetic Algorithm is used to reduce the problem of malaria vectors (Anopheles mosquitoes) shifting from their traditional locations to invade new zones is an important concern. Also in this paper we apply a fuzzy logic approach for classifying the shape of a mass. As well as information that lead to earlier diagnosis and more efficient treatment. We will make comparison study between AI techniques in which their performance, accuracy and another measures.

2. Related research

All 2.1 In(Judith A Omumbo 2004) conducted a research study in Kenya that addressed the spread of the malaria parasite in the most important age group is children from the ages of one to 15 years of age Use the model climate-driven

fuzzy model of suitability (FCS) for stable transmission developed by the Mapping Malaria Risk in Africa collaboration (MARA). Where the composition of a three-classes (0%, > 0 - <25% and ≥ 25%) and three classes of FCS (0, > 0 - <0.75 and ≥ 0.75) were tested using the kappa (k) statistic and examined as continuous variables to define better levels of agreement. He has built the form on the following equation:

$$y = \cos^2 \left[\frac{(x - U)}{(S - U)} * \frac{\pi}{2} \right]$$

As they represent x is a climate parameter, U is the value of x when conditions are unsuitable, and S is the value of x when conditions are suitable. When S is greater than U the suitability (1-y), increases with x; when S is less than U the suitability y, decreases as x increases. The model defines a monthly increasing curve (S = 22 C, U = 18 C) and decreasing curve (S = 22 C, U = 40 C) for mean diurnal air temperature, a monthly increasing curve (S = 80 mm, U = 0 mm) for rainfall, and a single increasing curve (S = 6 C, U = 4 C) for annual minimum temperature. The results were as shown in the following table:

Table 1. Agreement between parasite prevalence categories among 217 surveys spatially congruent categorical values of the Fuzzy Climate Suitability (FCS) using the 0.75 threshold for stable endemic malaria.

Graphics	FCS=0.00	FCS> 0 - <0.75	FCS>=0.75	Totals
Parasite prevalence 0%	3	5	0	8
Parasite prevalence 0> - < 25%	6	58	8	72
Parasite prevalence >=25%	0	58	97	137
Totals	9	121	87	217

2.2 In (2009 conducted a research study carried out by Henri EZ Tonnang) talked about three types of female mosquito carrying the malaria parasite, the study also spoke about the impact of weather changes in the spread of these three types of female mosquito. He has been used by The genetic algorithm for rule-set prediction (GARP) model was used to predict the geographical and ecological distribution of three

species of the *A. gambiae* complex (*A. gambiae*, *A. arabiensis*, and *Anopheles quadriannulatus*). Has been adopted to construct the model on the following mathematical equations:

1.
$$GI_A = \sum_{i=1}^{52} \frac{TIW * MIW}{52},$$
2.
$$SI = (1 - \frac{CS}{100})(1 - \frac{DS}{100})(1 - \frac{HS}{100})(1 - \frac{WS}{100}),$$
3.
$$SX = (1 - \frac{CDX}{100})(1 - \frac{CWX}{100})(1 - \frac{HDX}{100})(1 - \frac{HWX}{100}),$$
4.
$$EI = GI_A * SI * SX,$$

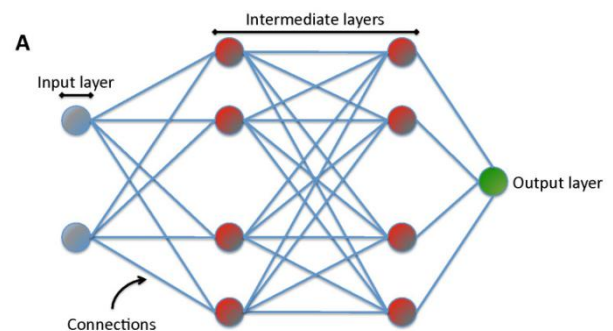
Where: TIW and MIW represent the weekly temperature and moisture respectively, 52 is the number of weeks in a year. CS, DS, HS and WS are the annual cold, dry, heat and wet stress respectively. CDX, CWX, HDX, HWX and EI are the annual cold-dry, cold-wet, hot-dry, hot-wet and ecoclimatic index stress interactions respectively. The model was used CLIMEX in sub-Saharan areas of Africa, by which the parasite carrier of the disease while taking into account the environmental factors affecting the lives of intermediate carrier of the disease is temperature and humidity were the results, as shown in the following table:

Table 2. CLIMEX parameters values for African malaria vectors to the *Anopheles gambiae* complex







Parameter designation	Values	
	<i>A. gambiae</i>	<i>A. arabiensis</i>
Moisture parameters (proportion of soil moisture holding capacity)		
Lower threshold of soil moisture (SMO)	0.35	0.15
Lower limit of optimal range of soil moisture (SM1)	0.70	0.40
Upper limit of optimal range of soil moisture (SM2)	1.50	0.60
Upper threshold of soil moisture (SM3)	2.50	0.80
Temperature parameter (C0)		
Lower threshold of temperature for population growth (DVO)	15	18
Lower optimal temperature for population growth (DV1)	28	30
Upper optimal for temperature for population growth (DV2)	35	38
Upper threshold of temperature for population growth (DV3)	40	44
Cold-wet stress indices		
Degree –days threshold of cold-wet stress (DTCW)	30.00	-

Moisture threshold of cold-wet stress (MTCW)	0.100	-
Rate of accumulation of cold-wet stress (PCW)	0.001	-
Dry stress indices		
Soil moisture dry stress (proportion of soil holding capacity) (SMDS)	0.260	0.300
Rate of accumulation of dry stress (HDS)	-0.006	-0.001
Wet stress indices		
Soil moisture wet stress (proportion of soil holding capacity) (SMWS)	2.50	0.900
Rate of accumulation of wet stress (HWS)	0.20	0.003
Heat stress indices		
Threshold of heat stress (TTHS)	40.00	44.00
Rate of accumulation of heat stress (TTHS)	0.001	0.0002
Cold stress indices		
Temperature threshold of cold stress (TTCS)	2.00	2.00
Rate of accumulation of cold stress (THCS)	-1.000	-1.000
Degree-days threshold of cold stress (DTCS)	25.000	15.000
Rate of accumulation of cold stress linked to degree-days (DHCS)	-0.002	-0.001

2.3 The application of artificial neural Networks to increase the accuracy of diagnosis of the symptoms of malaria were not available earlier study in the continent of Africa to facilitate the search process, but there is a study conducted in Brazil, addressed to determine the symptoms of malaria, using artificial neural Networks, has been the choice of Brazil as it is located in the same latitude, the same environment Climate This study was conducted in May 2010, was conducted by Bruno B Pndrade, having concluded that the diagnostic accuracy rate rose to 80% of what was in the past. To increase this rate used microscopy, nested PCR and an expert computational system based on artificial neural networks (MalDANN) using epidemiological data were compared with Compared to the rapid screening rapid diagnosis test (RDT). The following graph and table shows how to use the model:



B General design of the Artificial Neural Network used by the MalDANN software

Software version	Input layer	02 intermediate layers	Output layer
MalDANN Epidemiologic	 Neurons Variables inputted 31 neurons Epidemiological variables* Age Sex Previous malaria episodes Months living in the endemic area Use of bed net	 Neurons 10 neurons Data processing to identify patterns	 Neurons 01 neuron Generation of malaria diagnosis
MalDANN Epidemiologic + cytokines	 Neurons 07 neurons Epidemiological variables + cytokine levels Cytokine plasma levels (pg/mL) IL-10 IFN-γ	 Neurons 10 neurons Data processing to identify patterns	 Neurons 01 neuron Generation of malaria diagnosis

2.4 Artificial neural network

Artificial neural networks (ANNs) are commonly known as biologically inspired, highly sophisticated analytical techniques, capable of modeling extremely complex non-linear functions. Formally defined, ANNs are analytic techniques modeled after

the processes of learning in the cognitive system and the neurological functions of the brain and capable of predicting specific variables from other external variables after executing a process of so-called learning from existing data[25].

2.5 Genetic Algorithm

GA are efficient search methods based on the principles of natural selection and population genetics in which random operators on a population of candidate solutions are employed to generate new points in the search space [26].

3. DISCUSSION

The present study used different artificial intelligence techniques that have their own advantages and disadvantages. The artificial neural network model is more flexible because it allows the construction of the model for the non-linear input variables. However, the relationship between each input variable and output variable in the construction process is a black box that is difficult to explain. Genetic algorithms can be introduced easily into new problem domains, due to their

operation requiring only a very small amount of problem-specific knowledge. A drawback of the domain independence is that a genetic algorithm sometimes achieves only a near optimal performance level, however, this problem can be tackled by exploiting the problem knowledge.

Fuzzy logic appears as a useful tool to perform decision making in real life problems.

The techniques are aimed to reduce the diagnosis time as well as increasing the accuracy percentage in classifying mass in malaria.

Fuzzy logic approach can be used to formalize and determine the fever of malaria that makes it very important in diagnosis.

4. CONCLUSION

The prediction of clinical outcome of patients after malaria plays an important role in medical tasks like diagnosis and treatment planning. These kinds of estimations are currently performed by clinicians using non-numerical techniques. Artificial neural networks are shown to be a powerful tool for analyze data sets where there are complicated non-linear interactions between the input data and the information to be predicted, and fuzzy logic appears as an useful tool to perform decision making in real life problems especially as the continent of Africa a high incidence of endemic diseases that affect the lives of human African.

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